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Board 260: Educational Contexts that Support Student Motivation Lead to Better Academic Outcomes in STEM: The Role of Mathematics Instructors in Student Motivation

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Educational Contexts that Support Student Motivation Lead to Better Academic Outcomes in STEM: The Role of Mathematics Instructors in Student Motivation

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Introduction

Instructors play a critical role in creating educational contexts that can support or thwart student motivation and success [1]-[3]. This impact can be explained by the cue hypothesis [4]-[5], which posits that students will look to situational cues in their learning environment to identify what is expected of them and what is valued. Typically, individuals are most sensitive to situational cues that are communicated by people in positions of power [6]. In learning environments, that it typically the instructor. Instructors can communicate cues about expectations for student success and the value of the learning material for students lives in the form of instructional practices and classroom policies. By observing their instructor's practices and experiencing their policies, students will form perceptions of their instructor's ability expectations and values for the course, which will in turn directly impact students' own beliefs and values [2].

Existing research has highlighted the impact of students' perceptions of instructor beliefs on their own beliefs and success. For instance, in a study with STEM students, Meunks and colleagues [2] found that students who perceived that their instructors believed in their ability to learn and grow had higher interest for the course and performed better in the course compared to students who perceived that their instructors did not believe in their ability to grow. Other research has tested the links between students' perceptions of instructor practices and students' own beliefs and success. For example, Patall and colleagues [7] reported that students who perceived that their instructors supported their freedom and choice in their approach to learning and invested efforts in incorporating students' perspectives into the course demonstrated a higher sense of autonomy. Additionally, students who perceived that their instructors provided more rationale for studying the course material perceived more value for the course. Collectively, while this research highlights some of the effects of teacher beliefs and practices on students' motivation, it remains unclear whether these motivational beliefs will then serve as mechanisms to impact students' performance in important STEM classes. Further, most of this research has been conducted with students in four-year colleges or with high school students, and the experiences of the diversity of students in two-year colleges are less understood.

Accordingly, in the present study, we examined students' perceptions of their instructor supportiveness on their motivation and academic performance in introductory math courses among a diverse sample of community college students. We grounded the study in the expectancy-value-cost motivational framework [8] and hypothesized that students' perceived instructor supportiveness would positively predict students' expectations for success (expectancy) and perceived relevance for the math coursework (value), and negatively predict perceived drawbacks associated with their coursework (costs). We also hypothesized that students' math expectancy and value would in turn positively predict, and perceived costs negatively predict, students' math achievement. To better understand the nature of the type of practices instructors implemented in their math classrooms, we also sought instructors' self-reported qualitative responses to complement the student responses.

Methods

Data was collected as part of a larger study (NSF HRD#2000507) that aimed to test the efficacy of a motivation-enhancing intervention. The analyses for this research are conducted on students in the control condition. Students (N = 615) were enrolled in introductory math courses across six community colleges in the Southeast United States (67.3% female; 58.2% first-generation;

32.7% Black, 11.1% Latinx, 50.7% White, 2.1% Asian, and 3.4% who selected other races). Students' perceptions of instructor support (measure adapted from [7]) were assessed at week 3, and their motivational beliefs—including expectancies for success, values for the course, and perceived costs (measures adapted from [9])—were assessed at weeks 3 and 12 of the Fall 2021 semester. Students' final course grades were obtained from the institution. Week 3 motivational indicators, as well as students' race, gender, generation status, and high school GPA, were included in our models to account for students' initial levels of motivation, demographics, and prior achievement. We also surveyed all 51 instructors (93% of the instructors for our 615 students) at week 12 to explore their teaching practices and attitudes toward student success.

Results

We conducted three separate path models, each including teacher supportiveness as the predictor, math expectancy (model 1), value (model 2), and perceived costs (model 3) as the mediators, and math course grades as the outcome. The reason for running three separate models instead of including all three mediators in one model was the high correlation (r = .59) and observed multi-collinearity between expectancies and values. Full information maximum likelihood (FIML) was used to handle missing data. The significance of the indirect effect was determined based on bootstrapped confidence intervals with 5,000 iterations. All analyses were conducted in MPlus (version 8.6). Results of the path model suggested that students who perceived their instructors to be more supportive early in the semester had higher expectations for success (b = .44; 95% CI [.17, .60]) and higher perceptions of math value (b = .36; 95% CI [.14, .60]) later in the semester. Students' perceptions of instructor support early in the semester did not significantly predict their math perceived cost later in the semester (b = -.10; 95% CI [-.31, .12]). Students' expectancies for success and values for math positively predicted their end-of-semester math grades (b = .76; 95% CI [.53, 1.00]; and, b = .37; 95% CI [.07, .67], respectively). Perceived math costs did not predict students' end-of-semester math grades (b = -.23; 95% CI [-.50, .03]). The indirect effect of perceived instructor supportiveness on math grades through expectancies for success (b = .30; 95% CI [.12, .52]) and values (b = .13; 95% CI [.02, .28]) was significant. This indirect effect was not significant though costs (b = .02; 95% CI [-.04, .09]; see Figure 1 for the path analyses results).

We also examined instructors' open-ended responses about their instructional practices to depict a more in-depth picture of the support that instructors provided their students in introductory math classes. A clear theme emerged from our examination of instructors' qualitative responses. Nearly 82% of instructors mentioned that they implemented strategies to help students find the math coursework more relevant to their lives. For example, one instructor mentioned:

"*As much as possible I try to discuss real-world connections and contexts with the students so that we can find purpose in what we are learning. The problems we work on involve real-world scenarios*."

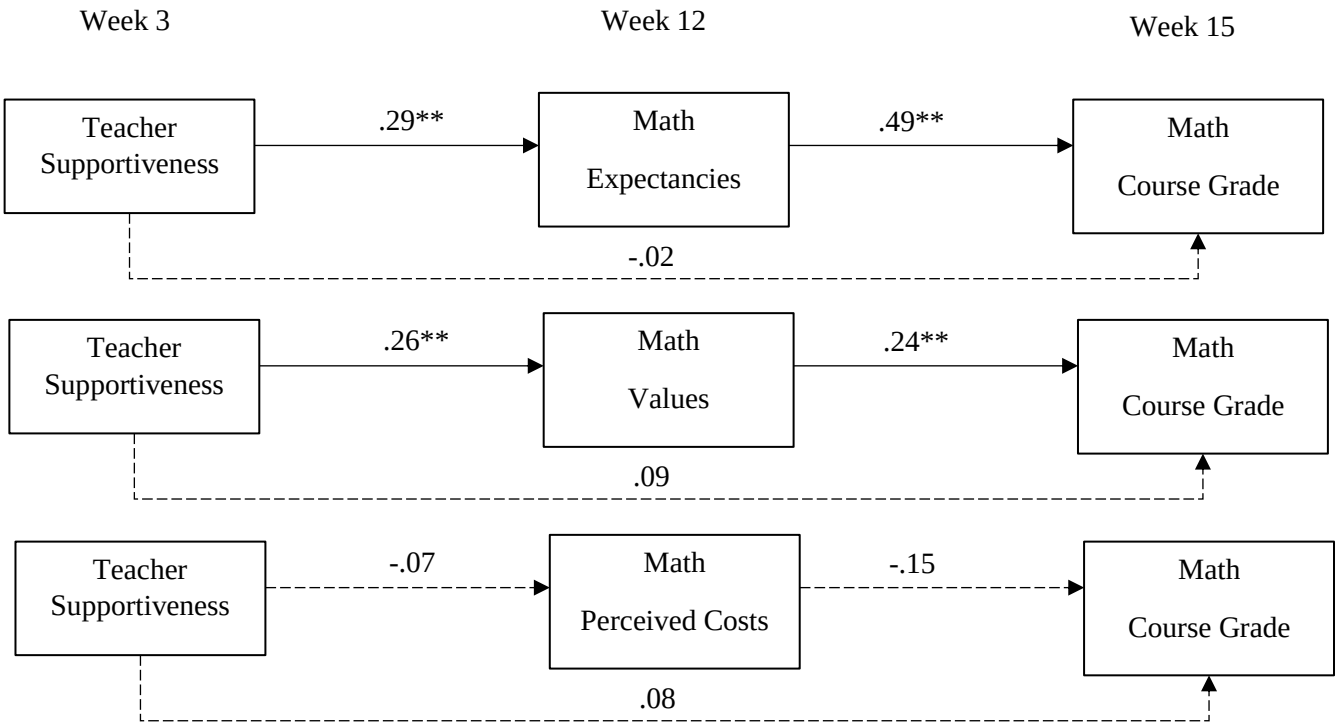
The rest of the instructors mentioned strategies such as encouraging adaptive help-seeking and incorporating students' perspectives in class activities. For instance, one instructor mentioned:

"[I] encourage students to reach out using a variety of communication platforms and provide immediate feedback on progress made in the course."

Another instructor mentioned:

"[I encourage] students to share solutions and we discuss how there are different approaches to problem solving."

Figure 1: *Standardized Coefficients for the Effects of Teacher Supportiveness on Expectancies, Values, Costs, and Math Course Grade*



Note. All models controlled for gender, URM status, generation status, high school GPA, and Week 3 expectancies, values, and costs, but were removed from this figure for clarity of representation. All models were saturated.
*$p < .05$; **$p < .01$

Discussion

The novel finding of our study was highlighting the motivational processes (i.e., expectancies and values) that explained the impact of perceived instructor support on grades. The present research revealed that students' perceptions of support from their instructors significantly impacted their motivation and achievement in math courses. In particular, students' beliefs in their instructors' support early in the semester increased their expectations for success in their introductory math courses and values for this course. The increase in success expectancies and values, in turn, resulted in higher achievement in math for students who had higher perceptions of instructor support. This finding is consistent with existing research, which suggests students who perceive that their instructors believe in them have better psychological and academic outcomes [2]. Additionally, this finding is consistent with social support literature, which suggests having access to robust social support (believing that one can ask for help and rely on others in times of difficulty) is related to higher expectations for success [11]. Unexpectedly, perceived instructor support did not predict students' perceptions of cost. Also, contrary to prior

theoretical and empirical research [8], perceived costs did not predict math grades. This lack of finding could be due to the measurement of our cost variable, which mostly included items assessing perceptions of time and effort invested in learning of math. It could be that community college students in our sample are concerned with other types of barriers to their motivation, perhaps loss of alternative opportunities because of job or family obligations (opportunity cost) or stress due to feeling academically underprepared for college (psychological cost). Therefore, future research should examine various types of perceived costs to reveal whether they are impacted by instructor supportiveness and can predict grades.

The qualitative examination of the instructor responses provided more depth to our quantitative findings. A clear theme emerged from our examination, suggesting that instructors attempted to highlight the real-word application of the math topics and encouraged students to make connections between what they learn in classrooms to their personal lives outside of class. Finding coursework relevant to one's life and the real world could increase students' values for the course, thereby increasing their performance in the course [12]. Other practices, such as providing support in times of need and incorporating students' perspectives in classroom activities, were also mentioned by instructors in our sample. These practices are considered supportive strategies that increase students' sense of autonomy and motivation [7].

Our results have implications for improving teaching practices. Instructors' attempts to highlight the utility and relevance of coursework could directly promote students' beliefs in their abilities to succeed, their values for coursework, and, in turn, their achievement in STEM.

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